

Onan

RV GenSet

Operator's Manual

BGE, NHE

Emerald Plus™ Series



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Safety Precautions

Before operating the generator set, read the Operator's Manual and become familiar with it and the equipment. **Safe and efficient operation can be achieved only if the unit is properly operated and maintained.** Many accidents are caused by failure to follow fundamental rules and precautions.

The following symbols, found throughout this manual, alert you to potentially dangerous conditions to the operator, service personnel, or the equipment:

⚠ DANGER *This symbol warns of immediate hazards which will result in severe personal injury or death.*

⚠ WARNING *This symbol refers to a hazard or unsafe practice which can result in severe personal injury or death.*

⚠ CAUTION *This symbol refers to a hazard or unsafe practice which can result in personal injury or product or property damage.*

FUEL AND FUMES ARE FLAMMABLE. Fire, explosion, and personal injury can result from improper practices.

- DO NOT fill fuel tanks while engine is running. Fuel contact with hot engine or exhaust is a potential fire hazard.
- DO NOT SMOKE OR USE AN OPEN FLAME near the generator set or fuel tank.
- Fuel lines must be adequately secured and free of leaks. Fuel connection at the engine should be made with an approved flexible, non-conductive line. Do not use copper piping on flexible lines as copper will work harden and become brittle.
- Be sure all fuel supplies have a positive shutoff valve.

GASOLINE AND LPG FUEL MAY BE ACCIDENTALLY IGNITED BY ELECTRICAL SPARKS, presenting the hazard of fire or explosion, which can result in severe personal injury or death. When installing the generator set:

- Do not tie electrical wiring to fuel lines.
- Do not run electrical lines and fuel lines through the same compartment openings.
- Keep electrical and fuel lines as far apart as possible.
- Place a physical barrier between fuel lines and electrical lines wherever possible.
- If electrical and fuel lines must pass through the same compartment opening, make certain that they are physically separated by running them through individual channels, or by passing each line through a separate piece of tubing.
- DO NOT SMOKE while servicing batteries. Lead acid batteries emit a highly explosive hydrogen gas that can be ignited by electrical arcing or by smoking.

EXHAUST GASES ARE DEADLY

- Never sleep in the vehicle with the generator set running unless vehicle is equipped with an operating carbon monoxide detector.
- Provide an adequate exhaust system to properly expel discharged gases. Inspect exhaust system daily for leaks per the maintenance schedule. Be sure that exhaust manifolds are secure and not warped. Do not use exhaust gases to heat a compartment.
- Be sure the unit is well ventilated.

MOVING PARTS CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Before starting work on the generator set, disconnect batteries. This will prevent accidental arcing.

- Keep your hands away from moving parts.
- Make sure that fasteners on the generator set are secure. Tighten supports and clamps, keep guards in position over fans, drive belts, etc.
- Do not wear loose clothing or jewelry while working on generator sets. Loose clothing and jewelry can become caught in moving parts. Jewelry can short out electrical contacts and cause shock or burning.
- If adjustment must be made while the unit is running, use extreme caution around hot manifolds, moving parts, etc.

ELECTRICAL SHOCK CAN CAUSE SEVERE PERSONAL INJURY OR DEATH

- Disconnect starting battery before removing protective shields or touching electrical equipment. Use rubber insulative mats placed on dry wood platforms over floors that are metal or concrete when around electrical equipment. Do not wear damp clothing (particularly wet shoes) or allow skin surfaces to be damp when handling electrical equipment.
- Use extreme caution when working on electrical components. High voltages can cause injury or death.
- Follow all state and local electrical codes. Have all electrical installations performed by a qualified licensed electrician. Tag open switches to avoid accidental closure.
- DO NOT CONNECT GENERATOR SET DIRECTLY TO ANY BUILDING ELECTRICAL SYSTEM. Hazardous voltages can flow from the generator set into the utility line. This creates a potential for electrocution or property damage. Connect only through an approved device and after building main switch is open. Consult an electrician in regard to emergency power use.

GENERAL SAFETY PRECAUTIONS

- Have a fire extinguisher nearby. Maintain extinguisher properly and become familiar with its use. Extinguishers rated ABC by the NFPA are appropriate for all applications. Consult the local fire department for the correct type of extinguisher for various applications.
- Hot coolants under pressure can cause severe personal injury. DO NOT open a radiator pressure cap while the engine is running. Stop the engine and carefully bleed the system pressure.
- Benzene and lead, found in some gasoline, have been identified by some state and federal agencies as causing cancer or reproductive toxicity. When checking, draining or adding gasoline, take care not to ingest, breathe the fumes, or contact gasoline.
- Used engine oils have been identified by some state or federal agencies as causing cancer or reproductive toxicity. When checking or changing engine oil, take care not to ingest, breathe the fumes, or contact used oil.
- Remove all unnecessary grease and oil from the unit. Accumulated grease and oil can cause overheating and engine damage, which presents a potential fire hazard.
- DO NOT store anything in the generator compartment such as oil or gas cans, oily rags, chains, wooden blocks, portable propane cylinders, etc. A fire could result or the generator set operation (cooling, noise and vibration) may be adversely affected. Keep the compartment floor clean and dry.
- Do not work on this equipment when mentally or physically fatigued, or after consuming any alcohol or drug that makes the operation of equipment unsafe.

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Section 1. Introduction

ABOUT THIS MANUAL

This manual provides information for operating and maintaining the Onan BGE/NHE gasoline and liquid withdrawal/LPG models of recreational vehicle generator sets. This manual covers both conventional compartment mount and underfloor mount installations.

Study this manual carefully and observe all warnings and cautions. Using the generator set properly and following a regular maintenance schedule can result in longer unit life, better performance, and safer operation.

HOW TO OBTAIN SERVICE

When the generator set requires servicing, contact an Onan authorized service center for assistance. Onan factory trained parts and service representatives are ready to handle all service needs. The Parts and Service Center Directory F-118, included with your generator set, lists the Onan representative nearest you. Copies of the warranty (AB-355) and parts catalog are also included in the literature package with your generator set.

When contacting an Onan authorized service center for parts or service, always supply the complete model number and serial number as shown on the Onan nameplate (Figure 1-1).

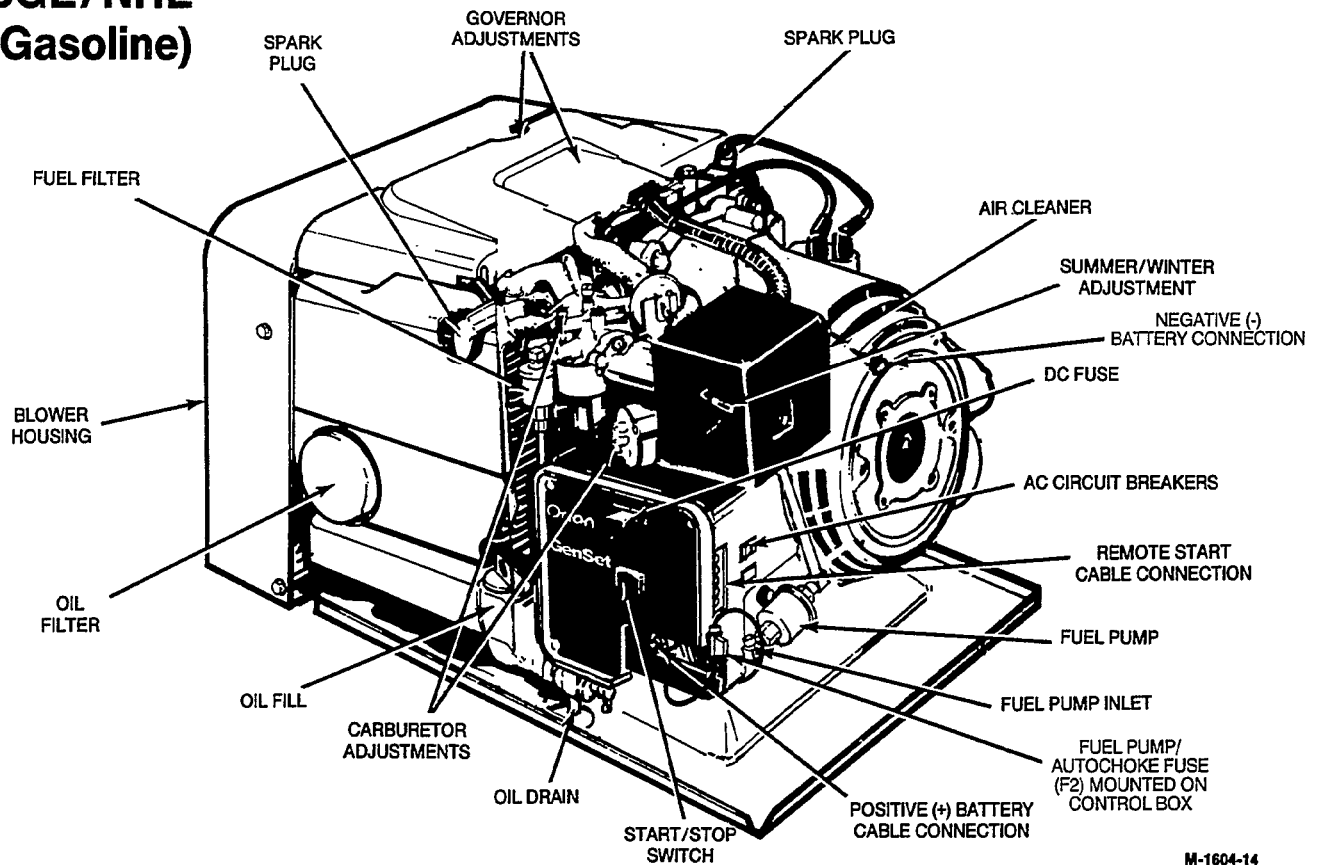
Model No.		
AC Volts:	Ph:	kW:
Amps:	PF:	RPM:
Fuel:	Hz:	Bat.: 12 V
Insulation - NEMA Class		Ambient 40°C
For Recreational Vehicle Use Only Pour Usage Dans Les Vehicules Recreatifs		
Onan Corp 1400 73rd Ave NE Minneapolis, MN 55432 USA		
Made in USA		LEB

FIGURE 1-1. ONAN NAMEPLATE

Section 2. Specifications

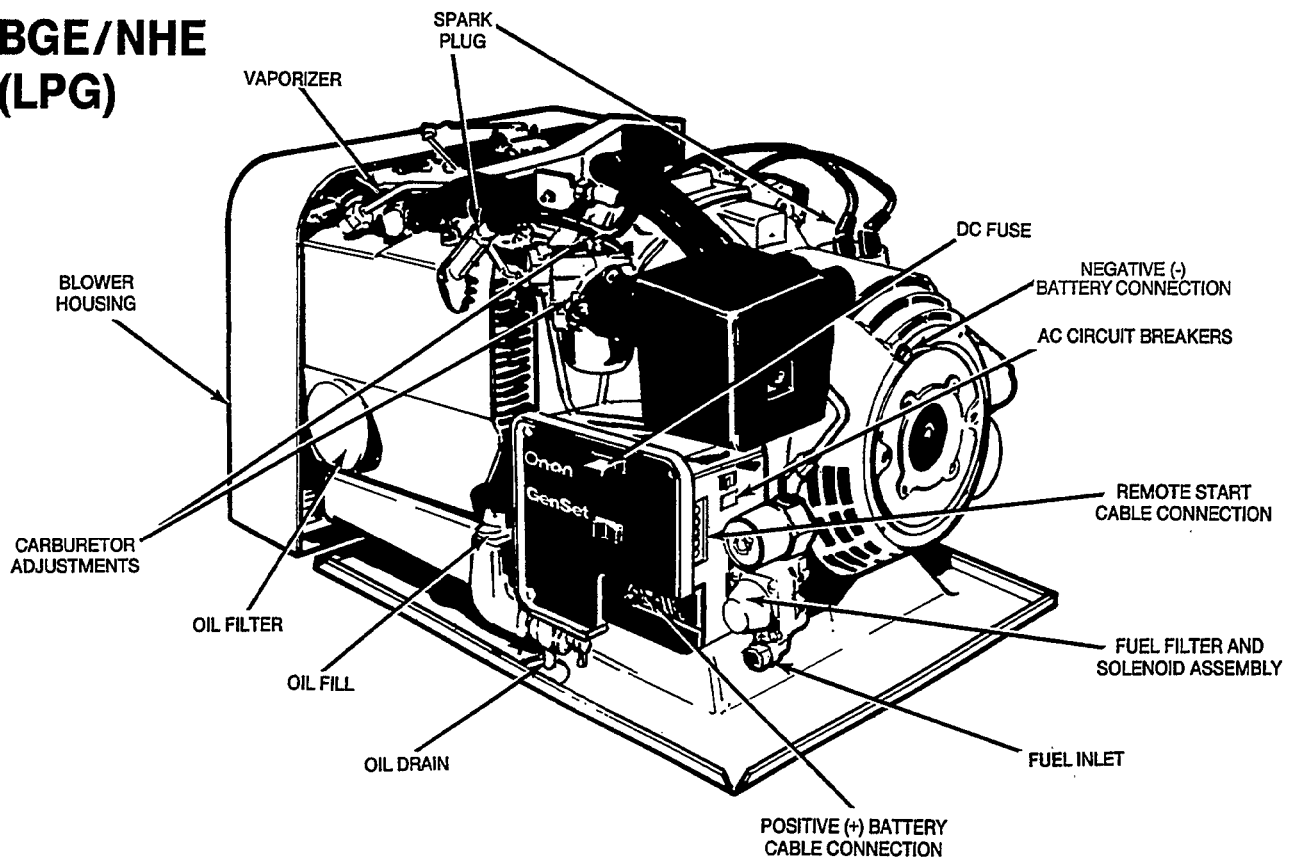
	BGE			NHE	
	50 Hz	60 Hz		50 Hz	60 Hz
GENERAL Weight Control Fuse Fuel Pump/Autochoke Fuse F2	204 lb (92.5 kg) 5 Ampere 10 Ampere (gasoline sets only)			230 lb (104 kg) 5 Ampere 10 Ampere (gasoline sets only)	
ENGINE Oil Capacity (includes filter) Tune-Up Specifications Spark Plug Gap Fuel Consumption - Gasoline No-load Half-load Full-load Fuel Consumption - Gasoline No-load Half-load Full-load Fuel Consumption - LPG No-load Half-load Full-load Speed (r/min)	3.5 U.S. quarts (3.3 L) 0.025 in. (0.64 mm) 4000 BGE: 0.4 gal/hr (1.5 L/hr) 0.6 gal/hr (2.3 L/hr) 0.8 gal/hr (3.0 L/hr) 5000 BGE: 0.4 gal/hr (1.5 L/hr) 0.7 gal/hr (2.6 L/hr) 1.0 gal/hr (3.8 L/hr) 0.5 gal/hr (1.9 L/hr) 0.8 gal/hr (3.0 L/hr) 1.3 gal/hr (4.9 L/hr) 1500			3.5 U.S. quarts (3.3 L) 0.025 in. (0.64 mm) 0.4 gal/hr (1.5 L/hr) 0.65 gal/hr (2.5 L/hr) 1.0 gal/hr (3.8 L/hr) 0.4 gal/hr (1.5 L/hr) 0.7 gal/hr (2.5 L/hr) 1.3 gal/hr (4.9 L/hr) 0.5 gal/hr (1.9 L/hr) 0.78 gal/hr (3.0 L/hr) 1.18 gal/hr (4.5 L/hr) 1500	
GENERATOR Power (Watts) Voltage Current (Amperes)	4000 110/220 or 120/240 36.4/18.2 or 33.3/16.7	4000 120 33.3	5000 120 41.7	5000 110/220 or 120/240 45.5/22.7 or 41.7/20.8	Gaoline-6500, LPG-6300 120 Gasoline-54.2, LPG-52.5
BATTERY RECOMMENDATIONS Size Capacity Cranking Current	12 Volts 360 Cold Cranking Amperes 60 Amperes				

BGE/NHE (Gasoline)



M-1604-14

BGE/NHE (LPG)



M-1604-9

FIGURE 2-1. TYPICAL EMERALD GENERATOR SETS

Section 3. Operation

▲WARNING

EXHAUST GAS IS DEADLY!

Exhaust gases contain carbon monoxide, an odorless and colorless gas. Carbon monoxide is poisonous and can cause unconsciousness and death. Symptoms of carbon monoxide poisoning can include:

- Dizziness
- Nausea
- Headache
- Weakness and Sleepiness
- Throbbing in Temples
- Muscular Twitching
- Vomiting
- Inability to Think Coherently

IF YOU OR ANYONE ELSE EXPERIENCE ANY OF THESE SYMPTOMS, GET OUT INTO THE FRESH AIR IMMEDIATELY. *If symptoms persist, seek medical attention. Shut down the unit and do not operate until it has been inspected and repaired.*

Never sleep in vehicle with the generator set running unless the vehicle interior is equipped with an operating carbon monoxide detector. Protection against carbon monoxide inhalation also includes proper exhaust system installation and visual and audible inspection of the complete exhaust system at the start of each generator set operation.

BEFORE STARTING

General Inspection

Before starting, open generator set access panel/door and perform visual inspection of unit and exhaust system. Look for loose or damaged components and fasteners. Correct as necessary.

▲WARNING *Exhaust gas presents the hazard of severe personal injury or death. Make sure all the exhaust components are operation-worthy and secure.*

Do not start generator set under a load condition. Check that vehicle switching device (if equipped) is at utility position, or vehicle AC distribution panel breakers are off. See Starting and Stopping, this section.

Confirm that vehicle is not parked in high grass or brush.

▲WARNING *Fire can cause severe personal injury or death. Do not operate the generator set when the vehicle is parked in high grass or brush.*

Do not operate the generator set if exhaust gases will not effectively expel away from vehicle.

▲WARNING *Exhaust gases can cause severe personal injury or death. Never operate the generator set unless the exhaust system is clear of walls, snow banks, or any obstruction that can prevent exhaust gases from dissipating. Never operate any exhaust fan in the recreational vehicle when the generator set is running. It can draw exhaust gas into the vehicle interior.*

Lubrication

Check the engine oil level. Keep the oil level as near as possible to the oil fill level indicator FULL mark. Do not overfill. See the *Maintenance* section for procedures.

▲WARNING *Hot oil can cause severe burns if spilled or splashed on skin. Keep fingers and hands clear when removing oil drain plug, and wear protective clothing.*

Fuel

Make sure the fuel tanks are full. See "Recommended Fuels" following.

▲WARNING *Fuel presents the hazard of fire or explosion which can result in severe personal injury or death. Do not allow any spark, flame, pilot light, lit cigarette, or any other ignition sources around fuel or fuel system components. Keep a type ABC fire extinguisher nearby.*

RECOMMENDED FUELS

Gasoline Models

Use clean, fresh, unleaded or regular grade gasoline. Using unleaded gasoline results in extended periods between service, longer spark plug life, and reduced carbon clean-out maintenance. If regular gasoline is used, lead deposits must be removed from the cylinder heads as required to reduce engine power loss. Unleaded gasoline can be used safely after regular gasoline usage if lead deposits have been removed from the cylinder head areas.

⚠CAUTION *Alternating between unleaded and leaded (regular) gasoline can result in engine damage unless lead deposits are removed from the cylinder head areas before using unleaded gasoline again.*

LPG Models

Use clean, fresh commercial propane or HD-5 grade liquid propane gas in a mixture of at least 90 percent propane. Propane fuels other than HD-5 can contain more than 2.5 percent butane which can result in poor fuel vaporization and poor engine starting in low ambient temperatures (below 32°F or 0°C).

A manual shutoff valve must be mounted on the propane fuel supply tank. This supply tank valve must be opened fully when operating the generator set to ensure the excess flow valve will close with a broken propane fuel line.

STARTING AND STOPPING

The following are general starting and stopping procedures. For initial start-up of unit, refer to Break-in Procedure.

At temperatures of 40°F (4°C) and below, disconnect all loads before attempting to start generator set.

1. Push the start-stop switch to the START position at the generator set control or at remote control (if equipped). Release the switch when the generator set starts.
2. Allow unit to warm up before connecting a load. During warm-up, observe unit operation. Confirm that unit performance is satisfactory.
3. Apply loads. Refer to *Specifications* section for generator set output and performance ratings. Refer to Table 3-1 for the approximate wattage usage of common appliances.

⚠CAUTION *Continuous generator set overloading can cause high operating temperatures that can damage the generator windings. Keep the load within the nameplate rating.*

TABLE 3-1. APPROXIMATE POWER REQUIREMENTS OF COMMON APPLIANCES

Appliance or Tool	Approximate Running Wattage
Refrigerator	600-1000
Electric broom	200-500
Coffee percolator	550-700
Electric frying pan	1000-1350
Hair dryer	800-1500
Electric stove (per element)	350-1000
Electric iron	500-1200
Radio	50-200
Electric water heater	1000-1500
Space heater	1000-1500
Electric blanket	50-200
Television	200-600
Electric drill	250-750
Battery charger	Up to 800
Air conditioner	1400-2000
Converter	300-500
Microwave oven	700-1500

4. To stop generator set, remove all loads and allow unit to run for three to five minutes to cool down. Then push the start-stop switch to the STOP position at the generator set control or at remote control.

BREAK-IN PROCEDURE

To prevent high oil consumption or glazing of the engine cylinders, Onan recommends breaking in the unit. The procedure is as follows:

1. After starting, plug in enough appliances to total one-half the generator set capacity (about 2,000 watts for BGE and BGEL; about 3000 watts for NHE and NHEL). Refer to Table 3-1 for the approximate wattage usage of common appliances.
2. Run the generator set with this load for two hours.
3. Operate the generator set at three-quarters capacity for another two hours.

These loads are approximations. If you do not have enough appliances in the vehicle for three-quarters capacity, engage as many appliances as you can.

4. Change the engine crankcase oil after the first 50 hours of operation and every 150 hours after that. See *Maintenance* section.

OPERATING CONDITIONS

Hot Weather

In hot weather (above 90°F/33°C), keep the cooling fins clean and see that nothing obstructs airflow to and from the generator set.

Cold Weather

Use the correct oil weight and type for cold weather conditions. See the *Maintenance* section. Change the oil only when the engine is warm. If sudden temperature variations occur and your current oil is not the appropriate viscosity, change the oil following the recommendations in the *Maintenance* section.

Gasoline Models Only: At temperatures below 40°F (4°C), move the carburetor air preheater lever to the WINTER position. The actuating lever is located on the outside of the air cleaner housing (see Figure 7). At temperatures above 70°F (21°C), move the preheater lever to the SUMMER position. Between 40°F (4°C) and 70°F (21°C), you can leave the preheater in either position.

⚠CAUTION *Operation of the preheater when temperatures are above 70°F (21°) can cause erratic operation and can result in reduced engine power and reduced engine life. For this reason, leave the preheater in the SUMMER position at high ambient temperatures.*

High Altitudes

Maximum power will be reduced about four percent for each 1000 feet (310 m) above sea level after the first 1000 feet (310 m). If operation is inhibited by high alti-

tude (above 2000 feet or 620 m), adjust the carburetor main fuel adjustment for a slightly leaner fuel mixture. Turn the main fuel adjustment in 1/8 turn. See Figure 3-1.

CAUTION *Fuel mixture adjustment needles and seats can easily be damaged. When adjusting fuel mixture settings, never force the fuel mixture adjustment needles against their seats.*

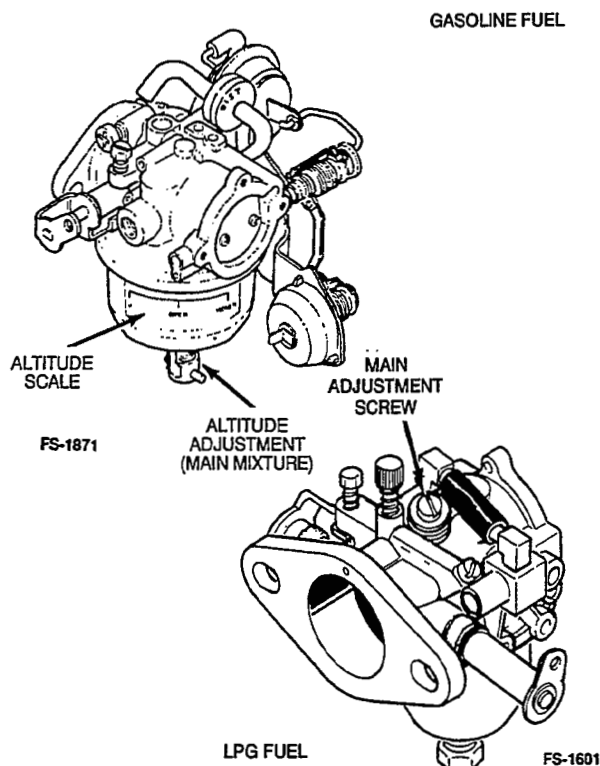


FIGURE 3-1. CARBURETOR MAIN ADJUSTMENT SCREW

Extremely Dusty or Dirty Conditions

1. Keep the generator set clean. Keep cooling surfaces clean.
2. Service the air cleaner as frequently as necessary.
3. Change the engine crankcase oil every 50 operating hours.
4. Keep oil in dust-tight containers.
5. Keep the governor linkage clean. The *Maintenance* section shows this procedure. Do not lubricate.

GENERATOR SET EXERCISE

Infrequent use can result in difficult starting and moisture condensation in the engine. Moisture is caused by the engine not running enough to reach normal operating temperature. If severe enough engine damage can result.

During infrequent use, guard against engine damage. Run the generator set at 50 percent capacity (BGE: 2000 watts; NHE: 3000 watts, or one air conditioner) for two hours every four weeks. Exercising for longer time periods is better than several short intervals.

REMOTE CONTROL

Optional remote start-stop controls are available for all Onan recreational vehicle generator sets. The remote control allows you to operate your generator set from inside your motor home.

The Standard remote control includes a start/stop switch, and an indicator lamp that illuminates when the set is operating. The Deluxe control contains these items plus a running time meter and a battery condition meter. See Figure 3-2.

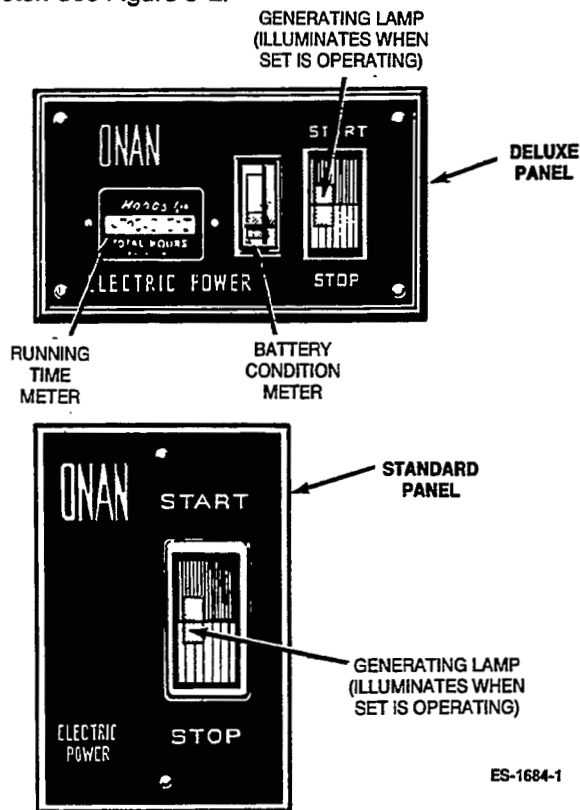


FIGURE 3-2. REMOTE CONTROL PANELS

Using the Remote Control

Move the start/stop switch to the START position and hold until the lamp illuminates (this indicates that the generator set is operating), then release the switch. See Figure 3-2.

If you held the switch at the START position for ten seconds and the lamp does not illuminate, release the switch. Wait two minutes and try again. If the second attempt does not start the generator set, start the unit at the set control. Failure of the lamp to illuminate may indicate an open circuit in the remote wiring. Contact an Onan dealer for assistance.

The running time meter indicates cumulative total hours of generator set use. Record hours indicated each time set maintenance is performed.

The battery condition meter indicates the relative condition of the battery, and battery charging circuit. The meter should remain in the normal zone. If meter reading is consistently high or low, contact an Onan dealer for assistance.

TABLE 3-2. TROUBLESHOOTING GUIDE

Table 3-2 is a simplified troubleshooting guide. If these recommendations fail to resolve the problem, contact an Onan service center.

Problem	Probable Cause	Solution
FAILS TO CRANK	<ol style="list-style-type: none"> 1. Low battery. 2. Bad battery connection. 3. Blown fuse. 	<ol style="list-style-type: none"> 1. Check battery electrolyte level. 2. Clean and tighten all battery and cable connections. 3. Replace fuse on control box. See specifications for proper fuse rating.
CRANKS SLOWLY	<ol style="list-style-type: none"> 1. Low battery. 2. Bad battery connection. 3. Oil is too heavy. 4. Load connected. 	<ol style="list-style-type: none"> 1. Check battery electrolyte level. 2. Clean and tighten all battery and cable connections. 3. Replace with lighter oil. 4. Remove load.
CRANKS BUT WON'T START	<ol style="list-style-type: none"> 1. Fuel below genset pick-up level in tank. 2. Fuel supply shutoff valve closed. 3. Carbon deposits on spark plugs. 4. Blown fuel pump/ autochoke fuse F2. 	<ol style="list-style-type: none"> 1. Add fuel. 2. Fully open fuel supply valve. 3. Remove spark plugs and clean. 4. Replace fuse with same type and rating. If problem persists, see Onan service center.
EXHAUSTING BLACK SMOKE	<ol style="list-style-type: none"> 1. Rich fuel mixture. 2. Dirty air filter. 3. Choke stuck. 	<ol style="list-style-type: none"> 1. Turn main fuel adjustment in 1/8 turn (location of adjustment is shown in Figure 3-1). 2. Replace air filter. 3. Contact an Onan service center.
UNIT RUNS THEN STOPS	<ol style="list-style-type: none"> 1. Out of fuel. 2. Low oil level. 3. Excess oil. 	<ol style="list-style-type: none"> 1. Refill fuel tank. 2. Add oil if necessary. 3. Reduce engine oil level.
UNIT RUNS BUT SURGES	<ol style="list-style-type: none"> 1. Loose or worn spark plug leads. 2. Ignition coil, wiring, or control components defective. 3. Faulty spark plugs. 4. Governor out of adjustment. 	<ol style="list-style-type: none"> 1. Check security of spark plug leads at spark plugs and ignition coil. Replace leads if worn. 2. Contact an Onan representative. 3. Remove and clean or replace spark plugs. 4. Contact an Onan service center.
CIRCUIT BREAKER(S) TRIP	<ol style="list-style-type: none"> 1. Too much load. 	<ol style="list-style-type: none"> 1. Reduce other AC loads (microwave, curling iron, etc.) when operating air conditioner(s).



WARNING *A hot generator set can cause severe burns. Always allow the generator set to cool before performing any maintenance or service.*

Section 4. Maintenance

GENERAL

Establish and adhere to a definite schedule for maintenance and service. If the generator set is subjected to extreme operating conditions, you should reduce the intervals accordingly.

Consult your Onan dealer if the generator set will be subjected to any extreme operating conditions and determine a suitable maintenance schedule. Keep an accurate log of all service and maintenance performed for warranty support.

Perform all the maintenance at the time period indicated or after the number of operating hours indicated. Use the schedule to determine the maintenance required, and then refer to the sections that follow for the correct procedures.

If you have the under-floor mount generator set and it must be lowered for any maintenance procedure (that is, you cannot service it in its normal position), see the procedure "Lowering the Under-Floor mount Generator Set" in this section before beginning the maintenance procedure.

⚠ WARNING *Accidental starting of the generator set during maintenance procedures can cause severe personal injury or death. Disconnect both generator set starting battery cables before performing maintenance; disconnect negative (-) cable first.*

TABLE 4-1. PERIODIC MAINTENANCE SCHEDULE

Service These Items	After Each Cycle of Indicated Hours				
	8	50	150	300	500
General Inspection	x ¹				
Check Oil Level	x				
Check Battery Electrolyte Level		x			
Clean Out Spark Arrester		x			
Clean Governor Linkage			x ²		
Change Crankcase Oil and Oil Filter			x ^{2,6}		
Change Air Filter				x ²	
Clean Carburetor & Combustion Chamber w/Onan "4C" Cleaner			x		
Check Spark Plugs					x ^{4,8}
Inspect and Clean Internally, Engine Combustion Chamber					x ⁵
Replace Fuel Filter (Gasoline) or Clean Fuel Filter (LPG)					x ³
Inspect and Pressure Test the LPG System					x ^{5,9}
Adjust Carburetor	As Required ⁵				
Check Generator Brushes	As Required ⁵				
Clean Generator Set	As Required ⁵				
Exercise Generator Set	As Required ⁷				

- ¹ - Before operating the set each day, or at least every 8 hours, check for oil and fuel leaks. Check exhaust system audibly and visually with generator set running. Shut down the set and repair any leaks immediately. Replace corroded exhaust and fuel line components before leaks occur. Make sure exhaust pipe extends beyond the perimeter of the RV.
- ² - Or once a year, whichever is first. Perform more often in extremely dusty conditions (i.e., check monthly, and change if dirty).
- ³ - Replace fuel filter at carburetor, clean screen at fuel pump⁵.
- ⁴ - Refer to Out-of-Service Protection if unit is to be stored.
- ⁵ - Have your Onan service center perform.
- ⁶ - First oil change during first year or 50 hours of operation, whichever is first.
- ⁷ - During periods of nonuse, exercise for 2 hours every 4 weeks.
- ⁸ - Replace if necessary.
- ⁹ - Perform more frequently if there are extended periods of nonuse.

GENERAL INSPECTION

Perform a general inspection of the generator set before operation each day or at least every eight operating hours. Start the generator set, and check for visible and audible irregularities. Make sure the exhaust pipe extends beyond the perimeter of the RV.

Exhaust System

Examine the exhaust system for leaks. Inspect the generator compartment for holes that might allow exhaust gas to enter the vehicle. Do not operate the generator set if it runs louder than usual, if the compartment has holes to the interior, or if the exhaust system has leaks or does not extend beyond the perimeter of the RV. Consult an Onan service center as soon as possible, and do not operate the generator set until the problem is corrected. Replace worn, damaged, or corroded exhaust components before leaks occur.

⚠ WARNING *Exhaust gas presents the hazard of severe personal injury or death. If there are any exhaust leaks, do not operate the generator set. Have the exhaust system repaired before using the generator set.*

Fuel System

With the generator set operating, inspect the fuel supply line, return line, filter, and fittings for leaks. Check any flexible sections for cuts, cracks, and abrasions and make sure they are not rubbing against anything that could cause breakage. Replace worn or hardened fuel line components before leaks occur.

⚠ WARNING *Fuel presents the hazard of fire or explosion that can result in severe personal injury or death. If any leaks are detected, have them corrected immediately. Do not start generator set until gas and fumes are purged from the area.*

DC Electrical System

With the generator set off, check the terminals on the battery for clean and tight connections. Loose or corroded connections create resistance that can hinder starting. Clean and reconnect battery cables if loose. Always remove the negative (-) battery cable first and install it last to reduce the risk of arcing and igniting explosive battery gases.

Mechanical

With the generator set stopped, check for any signs of mechanical damage and investigate anything that indicates possible mechanical problems. With the set running, listen for any unusual noises that may indicate mechanical problems. If any problems are found, have them corrected immediately.

LUBRICATION SYSTEM

The engine oil was drained from the crankcase prior to shipment. Before the initial start, the engine must be filled with oil of the recommended classification and viscosity. Refer to the *Specifications* section for the lubricating oil capacity.

Be sure the engine crankcase is filled with oil to the FULL mark on the oil level indicator (Figure 4-1). If adding oil between changes, use the same brand; different brands might not be compatible when mixed. See *Recommended Engine Oil* in this section.

Add oil until it reaches the FULL mark on the oil level indicator (see *Checking Engine Oil Level*). Make certain not to overfill; excess oil may foam in the crankcase and stop the engine. Always replace the oil level indicator tightly, to avoid leakage.

⚠ WARNING *Hot oil can cause severe personal injury. Do not check the oil level while the generator set is running: oil may blow out of the oil fill tube.*

Checking Engine Oil Level

1. Remove the oil level indicator and wipe it with a clean rag.
2. Screw the oil level indicator back into its normal operating position (fully in).
3. Unscrew the indicator again, and check the oil level on the indicator stem.
4. Add oil as described above.

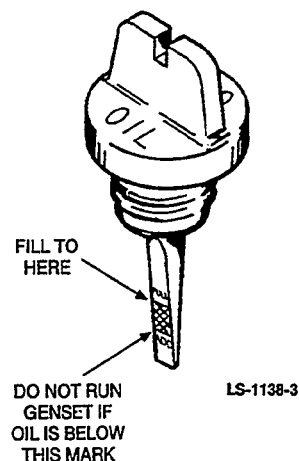


FIGURE 4-1. OIL LEVEL INDICATOR

Oil Changing Procedures:

Figure 1-2 shows the location of the oil drain, oil filter and oil level indicator. In dusty or dirty conditions, change the oil more frequently than specified in the *Maintenance Schedule*.

Run the engine until warm before draining the oil.

▲WARNING *Hot oil can cause severe burns if spilled or splashed on skin. Keep fingers and hands clear when removing oil drain plug, and wear protective clothing.*

Oil Draining Procedure

1. Place a pan under the oil drain valve.
2. Open the valve and allow oil to drain from the engine.
3. Close the valve. Dispose of the old oil properly.

▲WARNING *Contact with used oil can cause cancer or reproductive toxicity. When checking or changing engine oil take care not to ingest, breath the fumes, or contact used oil.*

Oil Filter Changing Procedure:

1. Place an oil pan under the oil filter location on the engine.
2. Turn the old filter slowly in a counterclockwise direction, wait for oil to stop draining, then remove filter.
3. Replace the oil filter only with a new Onan-approved oil filter. Coat the new filter gasket lightly with clean engine oil.

▲CAUTION *Incorrect replacement of service parts can result in damage to equipment. Use genuine Onan replacement filters only.*

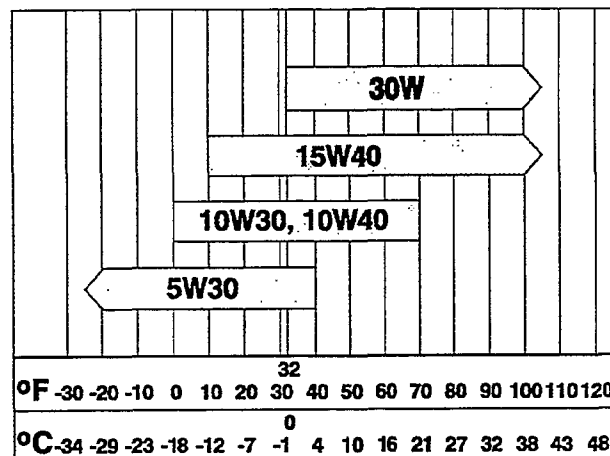
4. Turn the new filter clockwise until its gasket just touches the filter mounting base, then tighten it an additional half turn.
5. Wipe up excess oil.

Refer to the *Specifications* section of this manual for the engine oil capacity. See the *Recommended Engine Oil* section to select the proper grade of oil.

Crankcase Oil Recommendations

Fill crankcase with correct amount of oil. Refer to *Specifications* for crankcase capacity. Use oils meeting the API classification SF, SF/CC, or SF/CD. Refer to chart below to determine the proper viscosity grade of oil to use. Straight weight oils are recommended for severe duty use and at temperatures above 32°F (0°C) for minimum oil consumption.

▲WARNING *Crankcase pressure can blow out hot oil, which can cause severe personal injury. Do not check oil while the engine is running.*



Anticipated Ambient Temperature

FIGURE 4-2. SAE VISCOSITY GRADES

BATTERY CARE

To increase battery life, perform these routine checks and preventive measures.

▲WARNING *Accidental starting of the set can cause severe personal injury or death. Disconnect the battery cables when repairs are made to the engine, controls, or generator. Always disconnect the negative (-) cable first, to reduce the risk of arcing and igniting explosive battery gases.*

1. Keep the battery case clean and dry.
2. Make certain that the battery cable connections are clean and tight. To remove the battery cables, use a terminal puller tool.
3. Identify the cable as positive (+) or negative (-) before making the connection. Always connect the negative (-) cable last, to reduce the risk of arcing.
4. Maintain the electrolyte level by adding distilled water as needed to reach the split-level marker in the battery. The water component of the electrolyte evaporates, but the sulfuric acid component remains. For this reason, add water, not electrolyte to the battery.
5. A battery should be charged if the specific gravity measures less than 1.215. When charging the battery, avoid overcharging. Stop the boost charge when the electrolyte specific gravity reaches 1.260, at approximately 80° F (27° C).

⚠ WARNING Battery electrolyte can cause severe eye damage and burns to the skin. Wear goggles, rubber gloves, and a protective apron when working with batteries.

⚠ WARNING Batteries present the hazard of explosion, which can result in severe personal injury. Do not smoke or allow any fire, flame, spark, pilot light, arc-producing equipment or other ignition sources around the battery area. Do not disconnect battery cables while the generator set is cranking or running; batteries give off explosive gases.

SPARK ARRESTER

The exhaust Spark Arrester is necessary for safe operation of the generator set. It requires periodic cleaning to maintain maximum efficiency. Consult the maintenance schedule for recommended cleaning intervals.

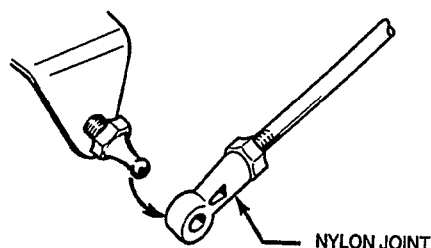
Spark Arrester Cleaning Procedure:

1. Remove the 1/8-inch pipe plug from the bottom of the muffler.
2. Run the generator set with load for five minutes.
3. Stop the generator set and allow the muffler to cool.
4. Replace the pipe plug in the muffler.

GOVERNOR LINKAGE

The governor linkage must move freely through its entire range of travel. A self-lubricating nylon joint is used that requires no additional lubricant. Wipe the joint with a dry cloth to clean it. Refer to Figure 4-3.

⚠ CAUTION Some solvents can damage the governor's nylon joint. Read the manufacturer's instructions before using any lubricants or solvents near the governor linkage.



FS-1592

FIGURE 4-3. GOVERNOR LINKAGE

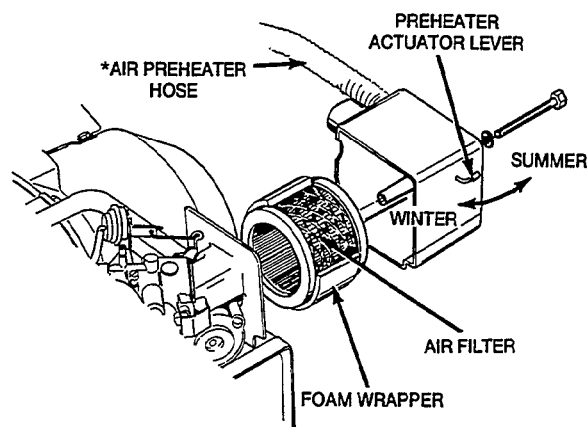
AIR FILTER

In dusty conditions, change the air filter often. Replace the air filter only with an Onan-approved filter. To remove the old filter, remove the through-bolt on the side of the air cleaner housing (Figure 4-4). Take care to properly align the new element in the air cleaner housing.

⚠ CAUTION The carburetor air preheater hose can easily be damaged by rough handling. When removing the air cleaner housing, be careful not to damage the carburetor air preheater hose, which is attached to the housing.

If the air cleaner is equipped with a foam wrapper, clean it as follows:

1. Wash element wrapper in water and detergent. Remove excess water by squeezing like a sponge. Allow wrapper to dry thoroughly.
2. Distribute one tablespoon of SAE 30 engine oil evenly around wrapper. Knead into wrapper and wring out excess oil.



*GASOLINE MODELS ONLY

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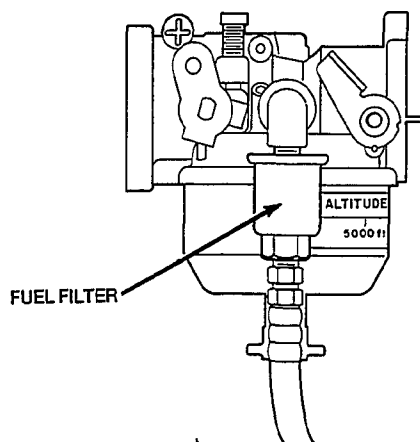
FIGURE 4-4. REPLACING THE AIR FILTER

FUEL FILTER (GASOLINE)

Change the fuel filter at the interval recommended in the Maintenance Schedule or if performance problems occur and bad fuel is suspected. Shut off the fuel supply valve and allow the set to operate until it runs out of fuel. Allow the generator set to cool down before replacing the fuel filter. Refer to Figure 4-5.

⚠ WARNING Fuel presents the hazard of fire or explosion that can cause severe personal injury or death. Do not permit any flame, spark, pilot light, lit cigarette, or other ignition source near the fuel system.

CAUTION *Incorrect replacement of service parts can result in damage to equipment. Use genuine Onan replacement fuel filters only.*



FS-1799

FIGURE 4-5. FUEL FILTER

FUEL FILTER (LPG FUEL)

The fuel filter (see Figure 4-6) removes solid impurities such as rust or scale from the LP-gas before they can clog the regulator or carburetor. A magnet within the filter housing traps iron or rust particles while a filter element traps non-magnet particles. The fuel filter operates at container pressure and must be carefully assembled after filter cleaning to prevent leakage.

To perform maintenance on the liquid LPG fuel filter, first purge the fuel system as described.

Purging Fuel System

1. Close the shutoff valve at the fuel tank.
2. Start the generator set and run until it runs out of fuel.
3. Crank engine a few times after it stops to make sure it is completely purged of fuel.
4. Move the recreational vehicle to a location that is well-ventilated and away from any spark, pilot light, lit cigarette, fire, flame, or other ignition source.
5. Remove the vehicle negative (-) battery ground cable and the generator set negative (-) ground cable from their respective batteries.
6. Close the fuel shutoff valves at the fuel tank for both the generator set fuel supply system and the appliance (stove, heater, etc.) fuel supply system. In addition, close the fuel shutoff valves at each appliance.

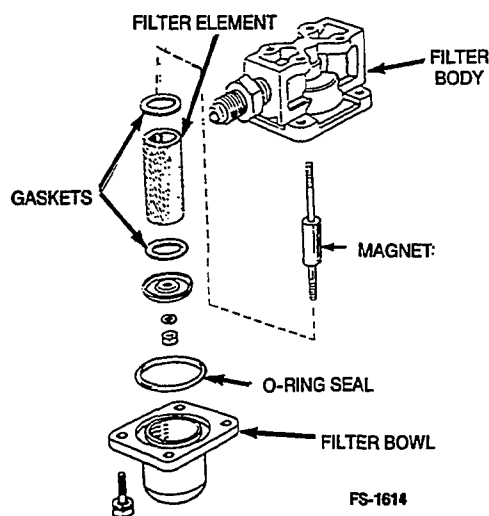
WARNING *Liquid LP gas presents a hazard of fire or explosion that can result in severe personal injury or death. Eliminate all sources of ignition such as lit cigarettes, flames, pilot lights and sparking electrical equipment before purging the fuel system. Provide adequate ventilation to dissipate LP gas as it is released.*

7. Slightly open the flexible section of fuel line at the solenoid valve just enough to allow the gas to escape slowly.
8. Disconnect the fuel supply hose from the carburetor and hold it clear of the set.
9. Press in and hold the primer button on the regulator to release LP gas from the set fuel system. When no more gas can be heard escaping from the open end of the fuel supply hose, reconnect the hose to the carburetor and proceed to *Cleaning Liquid LPG Fuel Filter*.

Cleaning LPG Fuel Filter

Clean the LPG filter using the following procedure. Refer to Figure 4-6.

1. Remove the four capscrews and lock washers that secure the filter bowl to the filter body.
2. Separate the filter bowl from the filter body and discard the O-ring seal.
3. Remove the nut and washer from the center stud and pull out the filter element.
4. If the filter element is clogged, wash the element in kerosene and blow dry with low pressure (30 psi or 207 kPa) compressed air. Replace the filter element if damaged.



FS-1614

FIGURE 4-6. LIQUID LPG FUEL FILTER

⚠ WARNING *Kerosene presents a hazard of fire or explosion that can cause severe personal injury or death. Do not expose the kerosene to flame, pilot light, lit cigarette or any arc-producing device. Clean with care.*

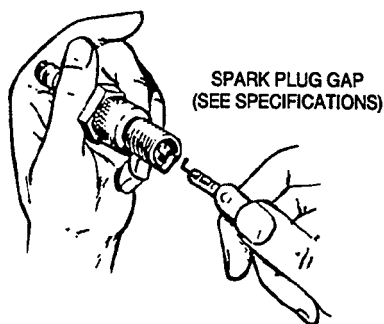
5. Wipe the center stud magnet clean of any rust or scale particles that have collected. Do not tap the magnet clean of loose particles; the magnet may become damaged.
6. Install a clean filter element using new gaskets (2) and securely tighten the center and stud nut.
7. Place a new O-ring in the filter bowl sealing groove.
8. Align the reference mark on the filter bowl with the reference mark on the filter body and install capscrews (4). Tighten capscrews 56 to 74 in. lb. (6.5 to 8.3 N•m) torque. When the fuel system is pressurized, check filter for leaks.

⚠ WARNING *Liquid LPG presents a hazard of fire or explosion which can result in severe personal injury or death. After assembly of the filter assembly and turning on the fuel shutoff valve, check to make sure the filter does not leak using a soap and water solution. If it leaks, turn off the shutoff valve immediately. If you cannot determine the source of the leak, call your nearest Onan service center.*

SPARK PLUGS

A spark plug with heavy combustion deposits can cause misfiring, poor operation, or stopping when a load is applied. Each time the spark plugs are removed, inspect, and regap (Figure 4-7). If a plug looks discolored or fouled, replace it.

- Black deposits indicate a rich mixture.
- Wet plug indicates misfiring (gasoline fuel only).
- Badly or frequently fouled plug indicates the need for a major tune-up.



ES-1374

FIGURE 4-7. MEASURING PLUG GAP

LOWERING AND RAISING THE UNDER-FLOOR MOUNT SET

If the under-floor mount generator set model must be lowered for maintenance or service (that is, it cannot be serviced in its normal position), use these procedures, following the instructions very carefully.

A floor jack is required to safely lower and raise the generator set. See Figure 4-8.

⚠ WARNING *The generator set falling can cause severe personal injury or death and equipment damage. Use a floor jack or other such device to control and support the weight of generator set when lowering and raising the unit. Do not attempt to lower or raise the generator set by hand.*

If generator set will be left in the down (tilted) position for more than thirty minutes, first drain the oil.

⚠ CAUTION *Oil in the engine cylinders can cause engine damage during starting attempts. Because oil can enter the engine cylinders when the generator set is lowered (tilted), do not leave the generator set in the lowered position for more than thirty minutes if the oil has not been drained.*

Lowering Under-Floor Generator Set

1. Park the recreational vehicle on as level a surface as possible.
2. Put the vehicle in its park position, lock the brakes, and remove the ignition key. Make sure no one moves the vehicle while performing this procedure.

⚠ WARNING *Dropping the generator set creates the hazard of serious personal injury or death. Make sure that no one moves the vehicle during this procedure and that the procedure is performed very carefully and only as indicated.*

3. Disconnect both battery cables, negative (-) cable first, at the generator set starting battery and open the generator set access door (if any).
4. If the generator set exhaust system is connected to or supported by the under-structure of the recreational vehicle, you will have to separate the exhaust system near the generator set before lowering the unit.
5. Check the electrical connections and fuel line to the generator set to make sure there is sufficient slack when lowering the generator set.

⚠ WARNING *Fuel presents the hazard of fire or explosion which can result in severe personal injury or death. Do not allow any spark, flame, pilot light, lit cigarette, or any other ignition sources around fuel or fuel system components. Keep a type ABC fire extinguisher nearby.*

6. Use a floor jack similar to the one shown in Figure 4-8 and position the floor jack under the reinforcement ribs of the drip tray as shown.

Use an adequate floor jack. Refer to *SPECIFICATIONS* section for unit weight.

⚠ WARNING *The generator set falling can cause severe personal injury or death and equipment damage. Use a floor jack or other such device to control and support the weight of generator set when lowering. Do not attempt to lower generator by hand.*

7. Raise the floor jack until it just makes contact with the drip tray, then just put a little upward pressure under the drip tray.

8. Remove the bolts from the front and rear (NHE only) support bracket(s), and remove the support bracket(s). This might require slight adjustment of the floor jack, either slight raising or lowering of the jack.

9. Once the support bracket is removed, all the weight of the generator set on that side is on the floor jack. Slowly lower the floor jack, being careful to allow the floor jack to roll as the generator set swings downward.

⚠ WARNING *The generator set falling can cause severe personal injury or death. Make sure the generator set is resting securely before moving the floor jack.*

10. Onan suggests you put some wood blocks under the drip tray assembly so that you can remove the floor jack. This will allow you more access room for the maintenance or service procedure.
11. Perform maintenance or service procedures.

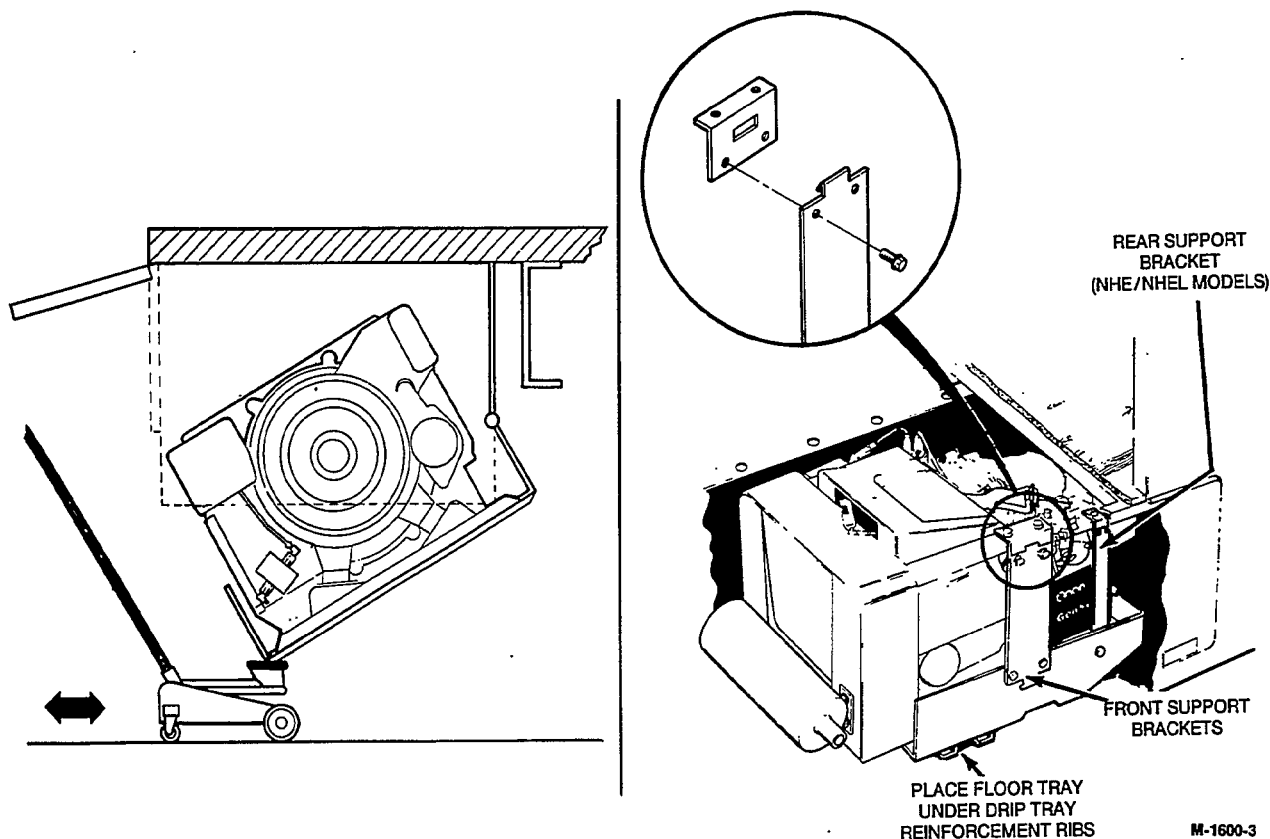


FIGURE 4-8. LOWERING UNDER-FLOOR MOUNT GENERATOR SET

Raising Under-Floor Generator Set

1. Reposition the floor jack under the reinforcement ribs of the drip tray. Before raising the generator set, make sure you will not damage any electrical connections, the fuel line, etc.
2. Slowly lift up the generator set.

Use an adequate floor jack. Refer to **SPECIFICATIONS** section for unit weight.

⚠WARNING *The generator set falling can cause severe personal injury or death and equipment damage. Use a floor jack or other such device to control and support the weight of generator set when lifting. Do not attempt to lift generator by hand.*

3. When the generator set reaches the upward limit, re-install the support bracket. You might have to make a slight adjustment with the floor jack, with slight raising or lowering of the jack to engage the safety support bracket hooks (on end of panel ends).
4. Use Loctite or similar thread locking material on the bolts used to secure the support bracket in place (ones removed from Step 8 of "Lowering Under-Floor Generator Sets"). Then install the 5/16-inch bolts to 14 ft-lb (19 N•m).
5. Fasten or secure any fuel line, and exhaust components moved or disconnected for this procedure. Make sure the exhaust components are put back in their original positions.

⚠WARNING *Exhaust gas presents the hazard of severe personal injury or death. Make sure all components are reinstalled in their original places and that the exhaust system is operation-worthy to prevent any exhaust leaks.*

6. Fasten battery cables at generator set terminals, if disconnected for this procedure.
7. Reconnect the generator set battery cables at the battery; first the positive (+) lead, then the negative (-) ground lead last.
8. If engine oil was drained for maintenance, refer to Engine Oil and replenish as necessary.
9. Close the access door (if any). The generator set should now be ready for operation.

CLEANING THE GENERATOR SET

Clean the generator set every six months, or more often if severe road contamination or dusty conditions are encountered. Dust usually can be removed with a damp cloth. However, steam may be necessary to remove certain road contaminants. Do not steam-clean the generator set while the engine is running. When cleaning the generator set, protect the generator, air cleaner, control box, and electrical connectors from the cleaning solutions. Do not clean with solvents; they may damage electrical connectors.

CLEANING THE CARBURETOR AND COMBUSTION CHAMBER WITH ONAN "4C"

⚠WARNING *Inhalation of chemical sprays can cause severe personal injury or death. Use safety goggles to protect eyes and a respirator or painter's mask to prevent inhaling any chemical that may spit back from the carburetor during this procedure. Also, work in a well-ventilated area so that other personnel will not inhale any fumes.*

⚠WARNING *Fumes from this cleaner presents the hazard of fire or explosion, which can cause severe personal injury or death. Do not allow any spark, flame, pilot light, lit cigarette, or other ignition source near generator set when performing this procedure. Keep a fire extinguisher rated ABC near work area. Perform the following steps, indicated on the maintenance schedule, to help keep the carburetor and intake manifold clean, and to keep carbon deposits from forming in the combustion chamber. If engine pinging or power loss occur, consult an authorized Onan service center.*

Before performing this procedure, move the vehicle to a well-ventilated outdoor location, far from any flame, spark, pilot light, arc-producing equipment or other ignition sources.

1. Start the generator set and allow it to warm up to normal operating temperature.
2. Stop generator set.
3. Remove the air cleaner housing and air filter.
4. Restart the generator set, and spray the "4C" into the carburetor, directing the spray to wash the choke plate and inside walls of the carburetor. Spray as much as possible into the carburetor without stalling the engine.

The spray enters the combustion chamber and softens the carbon, which flakes off and is expelled through the exhaust pipe. When about an ounce of the chemical remains in the can, flood the engine until it stops.

5. Do not start the engine for 15 minutes, while the "4C" continues to soften the carbon.
6. Restart the engine, with no electrical load attached. Increase the load on the generator set as gradually as is possible, to full load. Let the generator set run under full load for a few minutes, to expel the carbon.

INSPECT AND CLEAN ENGINE (INTERNAL)

Running the generator set under widely varying operating conditions, running the engine at less than 50 percent load, and using fuel with additives and impurities can impede engine performance and shorten engine life.

Have the engine combustion chamber inspected internally by an Onan service representative for component wear and carbon buildup after approximately 500 hours of use. Because this procedure requires removing the cylinder head, it must only be performed by an Onan service representative, trained in generator set maintenance and repair.

OUT-OF-SERVICE PROTECTION

If the generator set cannot be exercised regularly, and it will not be in use for more than 30 days, it must be stored.

Generator Set Storage Procedure

1. Run the generator set at 50 percent load for one hour.
2. Turn off the fuel supply and remove the air filter. As the generator set runs out of fuel, squirt defogger into the carburetor intake and reassemble the air filter.
3. Stop the generator set. Remove the spark plugs. Pour one tablespoon (about 30 ml) of clean engine oil into each spark plug hole. Crank the engine for 10 seconds. Replace the spark plugs.
4. Change the oil when the exhaust system has cooled.

▲WARNING

Hot oil can cause severe burns if spilled or splashed on skin. Keep fingers and hands clean when removing oil drain plug, and wear protective clothing.

▲WARNING

Contact with used oil can cause cancer or reproductive toxicity. When checking or changing engine oil take care not to ingest, breathe the fumes, or contact used oil.

5. Disconnect the cables from the starting battery, negative (-) cable first to reduce the risk of arcing.

Returning the Generator Set to Operation

1. Inspect the generator set.
2. Check the battery electrolyte level, and reconnect the cables, negative (-) cable last, to reduce the risk of arcing.

▲WARNING

Battery electrolyte can cause severe eye damage and burns to the skin. Wear goggles, rubber gloves, and a protective apron when working with batteries.

▲WARNING

Batteries present the hazard of explosion which can result in severe personal injury. Do not smoke or allow any spark, flame, pilot light, arc-producing equipment or other ignition sources around the battery area.

3. Check the air filter. If it is dirty, replace it.
4. Check the engine oil level.
5. Turn on the fuel supply.
6. Start the generator set at the set control. Initial start-up may be slow, due to oil in the cylinders. Smoke and rough operation will occur until the oil in the cylinders is burned. If the engine does not start, replace the spark plugs.
7. Apply 50 percent load to the generator set until it runs smoothly. Run the generator set for an hour.
8. Remove the load and let the generator set run for three to five minutes to cool down. Then move the Start/Stop switch to the STOP position. The generator set is now ready for operation.



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